(12) UK Patent Application (19) GB (11) 2 323 717 (13) A

(43) Date of A Publication 30.09.1998

(21) Application No 9804024.9

(22) Date of Filing 25.02.1998

(30) Priority Data
(31) 19707736 (32) 27.02.1997 (33) DE
(31) 19805577 (32) 12.02.1998

(51) INT CL[6]
H02K 7/14 5/26 // B24B 23/06

(52) UK CL (Edition P)
H2A AKL2 AKX2A AK108 AK121 AK213S AK214S AK215B AK220S AK403 AK405 AK810
U1S S1652

(56) Documents Cited
US 5642008 A US 3908139 A

(58) Field of Search
UK CL (Edition P) F1F FAX FEX, H2A AKLL AKL1 AKL2 AKX2A
INT CL[6] F01C 21/10, H02K 5/26 7/14

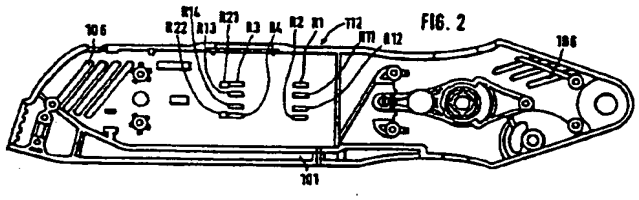
(71) Applicant(s)
Robert Bosch GmbH
(Incorporated in the Federal Republic of Germany)
Wernerstrasse 1, Stuttgart-Feuerbach,
D-70442 Stuttgart, Federal Republic of Germany

(72) Inventor(s)
Gerd Berner

(74) Agent and/or Address for Service
A A Thornton & Co
Northumberland House, 303-306 High Holborn,
LONDON, WC1V 7LE, United Kingdom

(54) Abstract Title
**Adjusting stator mounting in an electric hand tool machine**

(57) A hand tool machine (10), comprising an, in particular, longitudinally divided housing (12), which may be assembled from shells (112, 212) and accommodates a motor (14) with fixed and moving parts, in particular stator and rotor (114, 214), for driving a tool, may be manufactured inexpensively in that the fixed part (114) of the motor (14) at its outside carries recesses (314, N21, N22), with which are associated corresponding projections (R11 to R14) inside the housing (12), which engage positively into the fixed part (114) and jointly with further projections (R1 to R8) serve as stops for aligning and arresting the motor (14) in the housing (12).



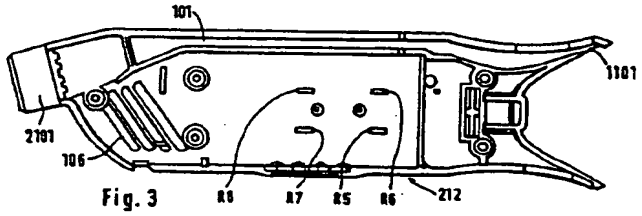



Fig. 3

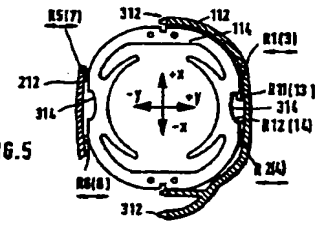


FIG.5

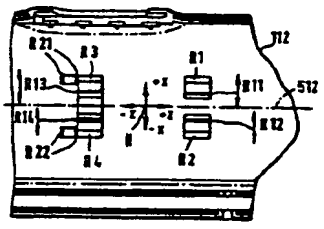


FIG.6

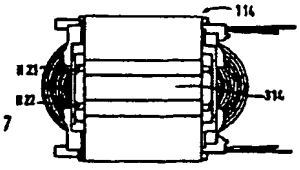


FIG.7

GB 2 323 717 A

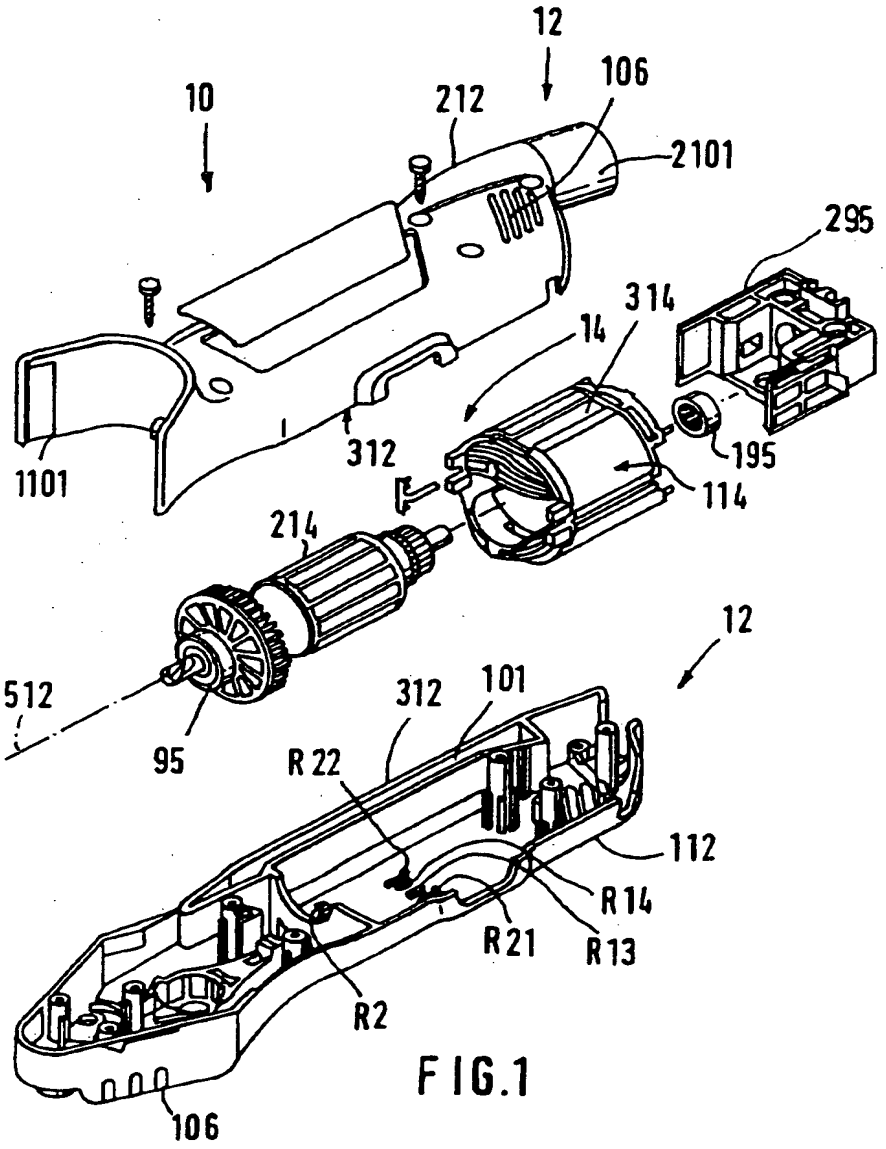

12
10
212
106
2101
295
314
14
1101
312
195
114
214
12
512
312
101
95
R 22
112
R 14
R 21
R 13
R2
106

FIG.1

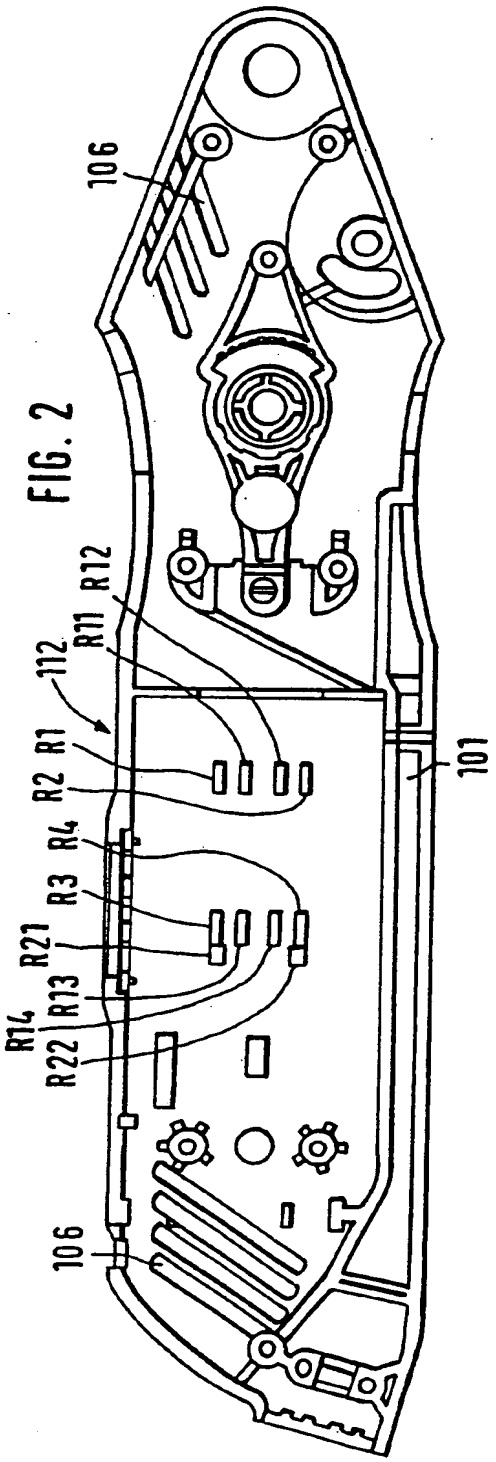

106
R11
R12
112
R1
R2
R4
R3
R21
R13
R14
R22
101
106

FIG. 2

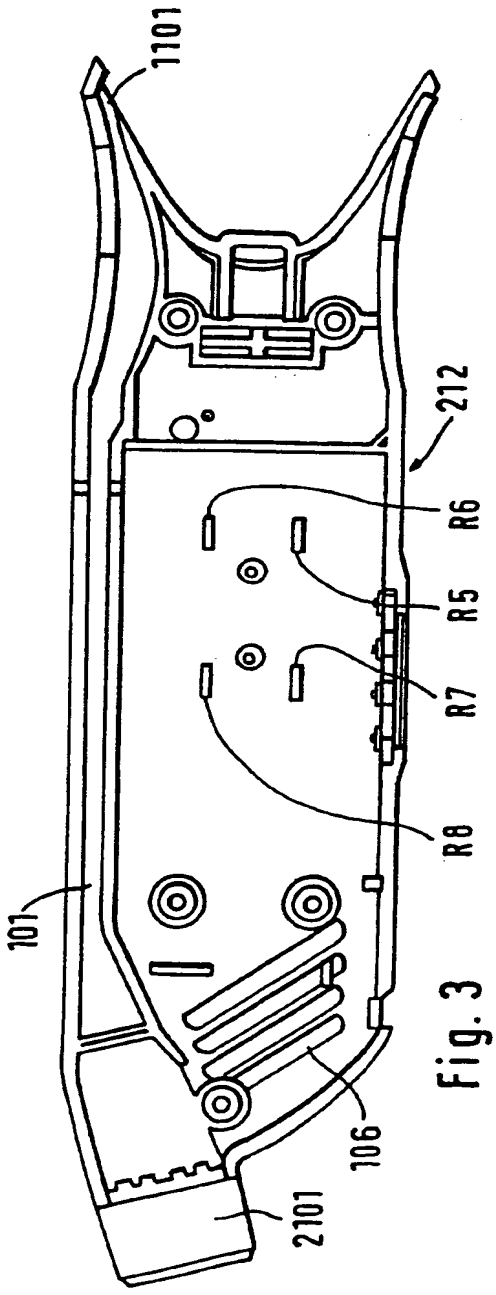

1101
212
R6
R5
R7
R8
101
106
2101

Fig. 3

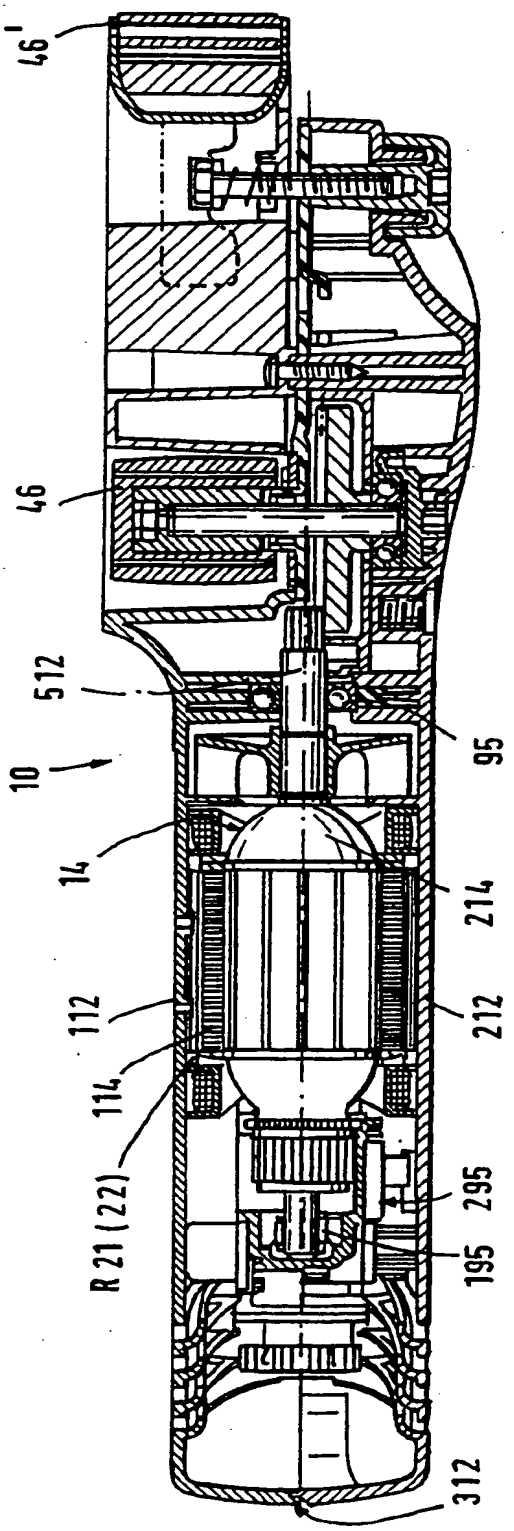



FIG. 4

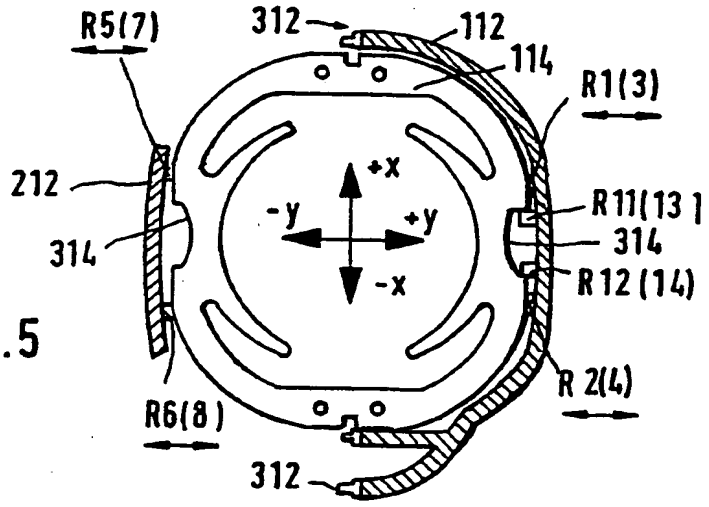



FIG.5

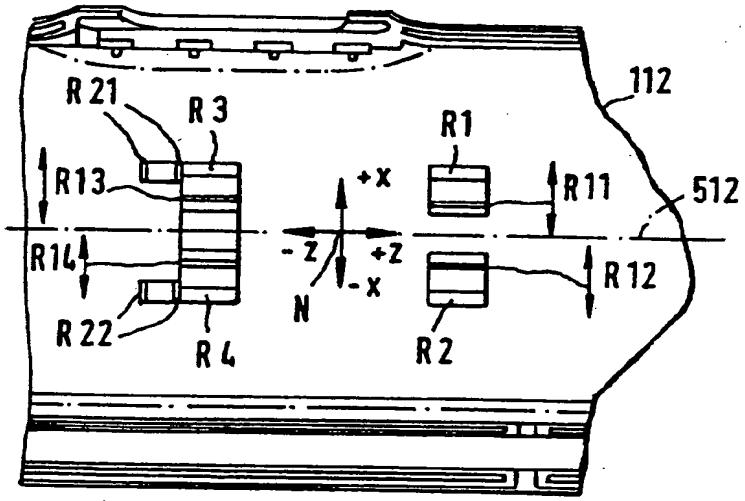



FIG. 6

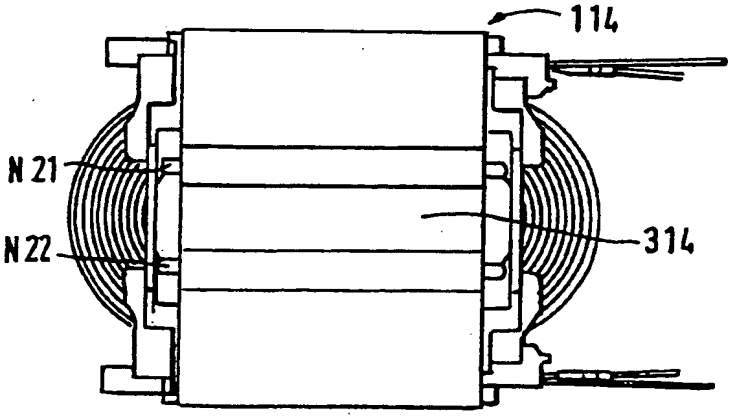



FIG. 7

# Electric hand tool machine

## Background art

The invention proceeds from an electric hand tool machine according to the preamble of claim 1.

In the case of electric hand tool machines operated with a.c. voltage, in particular, it is necessary for the machine housing simultaneously to form the motor housing of the electric motor with correspondingly high accuracy requirements. The only exceptions are cases where the electric motor is seated fully enclosed in its own housing, which accommodates the individual parts of the motor, e.g. rotor and stator, mounted in a precise and secure manner relative to one another. The problem still remains of designing the housing in such a way that the enclosed motor is in precise engagement with a means of transmitting motion to the tool, e.g. a gearing, disposed in the same or a separate, e.g. flange-mounted, housing.

With shell-type hand tool machine housings there is the problem of ensuring the correct positions between rotor and stator which are necessary for operation of the electric motor and of holding, on the one hand, the stator in a fixed manner and the rotor in a movable manner between the housing shells in such a way that the rotor axis is held precisely in the position, in which it may come into engagement with gearing of the adjacent gearing area of the hand tool machine. Rotor and stator moreover have to be precisely aligned with one another to enable the electric motor to achieve its optimum operating state. In the present case, the rotor is held in a rotatable and axially non-displaceable manner in the machine housing by means of two rolling-contact bearings held in bearing seats in each housing shell. Similarly, the stator is held fast directly between the housing shells, supported in

a precise, predetermined position against their walls by means of defined projections which ensure positive engagement.

When manufacturing the casting mould (injection moulding) for the housing shells, ensuring the repeat accuracy of the casting in the region of the defined projections has up till now been very laborious because production-related inaccuracies and shrinkages of the casting workpiece, i.e. the plastic housing, are impossible to predict with an acceptable outlay, with the result that the mutual alignment of armature and stator in the prototype housing is imprecise. The "inaccuracies" of the real positions of armature and stator relative to one another are measured and the dimensions of the casting mould in the region of the projections are accordingly purposefully modified as often as is necessary to achieve the required casting accuracy of the casting workpiece. Said process is therefore an iterative process involving a plurality of experimental steps, the number of the necessary iterative loops depending upon how many times the stator has to be shifted in the three coordinate directions and rotated about the longitudinal axis before adopting the correct position in the housing. During said iterative loops, the position of the rotor mostly remains constant so that "only" the stator position relative to the rotor is to be corrected. For said purpose, the dimensions of the differently shaped projections and/or ribs for receiving the stator in the housing shells are modified until the stator is mounted accurately relative to the rotor. Since only the rib regions of the casting mould are to be altered, the removal of material remains local and limited in quantity so that it is finally possible to effect serial casting of housing shells, in which the stator in its mounted state is aligned precisely relative to the rotor. Up till now, said ribs have been disposed in such a way that a shift of the stator in a specific coordinate direction entails the modification of, if not all, then at least several of the ribs. As a result, a relatively high number of iterative loops is required and the effort

involved in manufacturing the necessary (injection) moulding die is time-consuming and expensive.

Advantages of the invention

In contrast, the electric hand tool machine according to the invention having the characterizing features of claim 1 has the advantage that after a low number of measuring and iterative steps the injection moulding die obtains its final, operationally advantageous shape and is usable for particularly cost-effective serial production of housing shells.

By virtue of the fact that the position and number of the ribs supporting the stator in the two housing shells is so selected that a shift or position correction of the stator may be effected by only one or only a few specific ribs, an adaptation of the injection moulding die to said measuring results is possible in most cases by means of only a single correction step. This applies both to shifting in accordance with the three coordinate directions and to a desired rotation of the stator about the longitudinal axis.

Once the injection moulding die has been correspondingly corrected, all the housing shells of the left or right housing half which are manufactured using said injection moulding die have ribs of such a position, shape and number that the motor always adopts its ideal position in the housing. A high-performance operation and life of the motor in the hand tool machine is therefore guaranteed, regardless of the relatively coarse tolerances of the plastic housing.

By virtue of the fact that modifications at one rib, e.g. for a shift in an axial direction, do not lead to an undesired reactive shift or rotation of the stator in

another direction, it is normally possible already after the first measurement to determine each necessary modification for each rib. A second iterative loop is then no longer required. In addition, the ribs are fashioned in such a way that most of the modifications may be carried out simply by removing surplus die material, i.e. by increasing the size of individual ribs. An addition of material in the injection moulding die is therefore unnecessary, with the result that the die modification costs and the duration of adaptation work may be kept low.

By virtue of the number and nature of the arrangement of the supporting ribs for the stator in the housing shells, corrections of the injection moulding die up to attainment of a reproducibly accurate stator position are considerably simplified.

By virtue of the fact that there is a strict separation of the functional surfaces of the ribs and/or webs according to individual coordinate directions, no modification of one of the ribs results in an undesired positional change of the stator in the support region of another rib.

By virtue of the fact that the fixed part of the motor at its outside carries recesses, with which corresponding projections, in particular specific ribs, inside the housing are associated, which engage into the fixed part and serve as stops for arresting the motor in an aligned manner in the housing, the position of the motor in the machine housing is locked in assembly position through positive engagement.

By virtue of the fact that the motor is an electric motor, the stator of which carries at its outside on opposing sides longitudinal grooves, into which projections in the form of ribs engage so as to be supported against each groove flank, said motor

may, without modification, be reliably aligned in the housing simply by means of the housing configuration.

By virtue of the fact that the housing at the inside carries transverse ribs, which are intended for application against the end of the stator, the position of the stator is locked extremely precisely in an axial direction.

By virtue of the fact that the injection moulding dies for manufacturing the housing shells have the negative impressions of the ribs in their practically smallest possible size, it is particularly easy to increase the size of the ribs of the housing shells by removing material in the injection moulding die.

By virtue of the fact that some of the ribs are arranged longitudinally and some of the ribs are arranged at right angles to the motor, preferential support directions are defined.

By virtue of the fact that a plurality of the ribs extending longitudinally relative to the motor are supportable against the stator outside of the latter's longitudinal groove, the stator is locked in position also through frictional engagement.

By virtue of the fact that the ribs extending longitudinally relative to the motor hold the stator centred relative to the geometric motor axis and that the ribs extending at right angles to the motor hold the stator axially aligned, the ideal position of the stator relative to a rotor mounted in the housing is particularly guaranteed.

Because the housing has an elongate contour, the rear region serving as a handle, in particular for two-handed operation, the housing during manipulation of the

hand tool machine is subject to extremely high stress and so the stator has to be locked in position particularly well.

Because the housing, in particular one of the housing shells, carries an extraction connection piece at the rear, a middle region of the dust extraction channel, particularly in the form of a flat channel, extending in both housing shells, the housing shells have to fit together extremely accurately and tightly and be deformation-proof in order to prevent dust from entering.

Because the housing shells are made of plastic material, they have relatively coarse tolerances, the compensation of which is extremely important when the motor is installed.

Drawings

There follows a detailed description of an embodiment of the invention with reference to the accompanying drawings.

The drawings show:

Figure 1 an exploded view of a hand tool according to the invention,

Figure 2 the inside view of the longer shell of the housing of the hand tool machine according to the invention,

Figure 3 the inside view of the shorter shell of the housing,

Figure 4 a longitudinal section of the hand tool machine at right angles to the butt joint,

Figure 5 a cross section of the hand tool machine in the region of the stator,

Figure 6 an enlarged inside view of the longer shell of the housing in the region of the ribs supporting the stator and

Figure 7 a side view of the stator.

Description of the embodiment

The exploded view according to Figure 1 of a hand tool 10 in the form of a hand band sander shows its housing 12, which comprises a longer and a shorter housing shell 112, 212, which housing shells 112, 212 may be joined together at a longitudinally extending, vertical butt joint 312.

The housing 12 accommodates a motor 14 comprising a stator 114 and a rotor 214, both parts being aligned in relation to a common longitudinal axis 512.

The rotor 214 is rotatably mounted at its front end in a rolling-contact bearing 95 and at its rear end in a rolling-contact bearing 195, the rear rolling-contact bearing 195 being seated in a bearing bridge 295 which is positionable between the housing shells 112, 212.

At its rear end, the shorter housing shell 212 carries an extraction connection piece 2101 of a dust extraction channel 101, the intake opening 1101 of which is disposed at the front in the shell 212 and is used to carry dust away from an abrasive belt or a drive roller 46 (Figure 4). The housing shells 112, 212 at the rear and towards the front carries vent slots 106, through which the cooling air may be taken in and blown out.

The stator 114 at the outside carries on each of opposing sides a longitudinal groove 314 into which, after insertion of the stator 114 into the housing shell 112, radially inward- projecting ribs R11, R12, R13, R14 (Fig. 2) disposed in said housing shell engage so as to align and fix the stator in position. The stator 114 is therefore centred relative to the axis 512 in the plane of the butt joint 312.

Further ribs R1, R2, R3, R4, R5, R6, R7, R8 disposed in the two housing shells 112, 212 (Figures 5, 6) are supported outside of the grooves 314 on either side of the stator 114 against the stator and centre the stator at right angles to the plane of the butt joint 312.

The ribs R21, R22 in the longer housing shell 112, as is clearly evident from Figure 1, project radially further into the interior than the adjacent ribs R13 and R14 and they therefore align and fix the axial position of the stator 114 in the housing 12 in that they engage positively into specially provided grooves N21, N22 (Fig. 7) at the end of the stator 114.

Figure 2 shows the longer housing shell 212 which carries both the ribs R1, R2, R3, R4 for alignment of the stator 114 in y direction as well as the ribs R11, R12, R13, R14 for engagement into the lateral groove 314 of the stator 114 and for alignment of the stator in x direction. It moreover carries the two radially far inward-reaching ribs R21, R22 for securing the stator 114 axially, i.e. in z direction, the coordinate system being evident from Figures 5, 6.

Figure 3 shows the opposing, shorter housing shell 212, which carries only the ribs R5, R6, R7, R8 for aligning and supporting the stator in y direction, said ribs cooperating with the ribs R1 to R4 of the longer housing shell 112.

Figure 4 shows a longitudinal section of the hand band sander 10 at right angles to the plane of the butt joint 312. It is clearly evident that the housing 12 comprises two centrally juxtaposed housing shells 212, 112 and accommodates a motor 14. The motor 14 comprises a stator 114, which is supported directly against the housing shells 112, 212 and concentrically embraces the rotor 214. The rotor 214 is mounted in the rear region of the hand band sander 10 in a rolling-contact bearing 195, which is seated centrically in a bearing bridge 295 held fast between the housing shells 112, 212. The front end of the rotor 214 projects in the form of a motor shaft 512 into the front region of the hand band sander 10 and is guided in the front rolling-contact bearing 95. The front end of the motor shaft of the rotor 212 via a right-angle gear (not described in detail) drives a drive roller 46 for driving an abrasive belt (not shown), which serves as a tool and is deflected over a front guide pulley 46'.

Figures 5 and 6 show, in the cross section and longitudinal section of the housing 12, that the alignment of the stator 114, of which the laminated core is shown without a winding, is effected in the three-dimensional X-Y-Z coordinate system. The zero reference point of said system lies on the Z axis, which corresponds to the longitudinal axis of the stator 114, halfway between the rib pairs R1, R11, R2, R12 and R3, R13, R14 and R4. The systematic alignment of the stator 114 is effected by the following ribs:

The ribs R1 to R4 in the longer housing shell 112 and the ribs R5 to R6 in the shorter housing shell 212 align the stator 114 - negatively or positively - only in y direction. The ribs R11 to R14 align the pole shoe 114 only in X direction, i.e. upwards or downwards. The ribs R21, R22 fix the stator 114 only in z direction, i.e. in longitudinal direction. A modification of the rib heights relative to the inner surface of the shells and/or a modification of the rib thickness therefore leads in

Claims

1. Electric hand tool machine (10), comprising an, in particular, longitudinally divided housing (12), which may be assembled from shells (112, 212) and accommodates a motor (14), which comprises stator, rotor (114, 214), in particular with brushgear (295), and is used to drive a tool,
characterized in that the stator (114) is disposed in the housing (12) in a position-locked manner in the three-dimensional X-Y-Z coordinate system by means of projections (R1 to R8) and (R11 to R14), which are in each case individually and independently of one another associated in a defined manner with in each case one of the coordinate axes.

2. Hand tool machine according to claim 1, characterized in that the stator (114), in particular at the outside, carries recesses (314, N21, N22), with which are associated, for positive engagement, corresponding projections (R11, R12, R13, R14) at the insides of the shells (112, 212) of the housing (12), which independently of one another and of further projections (R1, R2, R3, R4, R5, R6, R7, R8) serve jointly with the latter as stops for aligning and arresting the stator (114) in the housing (12).

3. Hand tool machine according to claim 1, characterized in that the recesses of the stator (114) take the form of longitudinal grooves (314), which are disposed at opposing sides and into which engage, so as to be supported against each groove flank, projections in the form of, in particular, elongate ribs (R11, R12, R13, R14), which

each case only to a change in the position of the stator 114 in relation to the coordinate axis X or Y or Z associated with the modified ribs, without there being any reactions on its position relative to one of the other coordinate axes.

This is of practical importance during manufacture of the casting mould as well as rapid iteration for dimensionally accurate correction, which takes account of shrinkage and other influences, of the position of the stator 114 through corresponding purposeful modification of the ribs by means of casting mould correction.

Figure 7 shows a side view of the stator 114, in which one of the lateral grooves 314 and two of the end grooves N21, N22 are visible.

It is regarded as self-evident that the invention extends to hand tool machines, which are provided with motors comprising, like an electric motor, a rotor and stator and similar parts, e.g. pneumatic operating mechanisms, and in which said parts have to be mounted with narrow tolerances relative to one another or relative to a gearing connection, which hand tool machines may be, for example, jig saws, right angle grinders, scrapers or the like, the motor housing of which is in particular used as a handle.

project in particular in a cam-like manner vertically inwards from the inner walls of the shells (112, 212) and align the stator (114) in X direction at their outsides directed towards the groove flanks.

4. Hand tool machine according to claim 3, characterized in that the ribs (R1 to R4) in the longer shell (112) and the ribs (R5 to R6) in the opposing shorter shell (212) at their rib crests align the stator (114) only in transverse direction (Y) in that, for example, the ribs of the one side are made higher and the ribs of the opposing side are made correspondingly shorter.

5. Hand tool machine according to claim 3 or 4, characterized in that the ribs (R21, R22) in the shells (112, 212) fix the stator only in longitudinal direction (Z), i.e. axially relative to the housing (12), the stator being supported in particular against their rib flanks.

6. Hand tool machine according to claim 3, 4 or 5, characterized in that some of the ribs (R1 to R8 and R11 to R14) extend longitudinally relative to the motor (14) and some of the ribs (R21, R22) extend at right angles to the motor (13).

7. Hand tool machine according to one of claims 3 to 6, characterized in that a plurality of the ribs (R1 to R8) extending longitudinally relative to the motor (14) are associated with the stator (114) so that the stator is supported outside of its longitudinal groove (314).

8. Hand tool machine according to one of the preceding claims, characterized in that the housing (12) has an elongate contour, the

rear region serving as a handle, in particular for two-handed operation.

9. Hand tool machine according to one of the preceding claims, characterized in that one of the housing shells (212) at the rear carries an extraction connection piece (2101), a middle region of the dust extraction channel (101), in particular in the form of a flat channel, extending in both housing shells (112, 212).

10. Hand tool machine according to one of the preceding claims, characterized in that the housing shells (112, 212) are made of plastic material.

11. An electric hand machine tool substantially as herein described with reference to the accompanying drawings.

The Patent Office

14

**Application No:** GB 9804024.9 **Examiner:** John Cockitt
**Claims searched:** 1-11 **Date of search:** 20 July 1998

## Patents Act 1977
## Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): H2A [AKL1, AKL2, AKLL, AKX2A]; F1F [FAX, FEX]

Int Cl (Ed.6): H02K [05/26, 07/14]; F01C [21/10]

Other:

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| A | US5642008A | WAXING | |
| A | US3908139A | SINGER | |

| | | | |
|---|---|---|---|
| X | Document indicating lack of novelty or inventive step | A | Document indicating technological background and/or state of the art. |
| Y | Document indicating lack of inventive step if combined with one or more other documents of same category. | P | Document published on or after the declared priority date but before the filing date of this invention. |
| & | Member of the same patent family | E | Patent document published on or after, but with priority date earlier than, the filing date of this application. |